

What is claimed is:

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1. A method for fabricating a resist pattern, comprising the steps of:
forming a pre-resist pattern through exposure treatment and development treatment, and
ash-treating the pre-resist pattern to form the resist pattern narrowed.
2. A fabricating method as defined in claim 1, wherein the ashing treatment is carried out by using a process gas composed of oxygen gas containing at least one of fluorine-based gas and nitrogen/hydrogen gas mixture.
3. A fabricating method as defined in claim 1 or 2, wherein the pre-resist pattern and the resist pattern is composed of a photoresist layer as a top layer and a polymethylglutarimide layer as a bottom layer.
4. A fabricating method as defined in claim 3, comprising the steps of:
forming the polymethylglutarimide layer on a given base material,
forming the photoresist layer on the polymethylglutarimide layer,
exposing and developing the photoresist layer via a given mask,
partially removing the remaining polymethylglutarimide layer with an alkaline water solution to form the pre-resist pattern, and
ash-treating the pre-resist pattern to the narrowed resist pattern.
5. A fabricating method as defined in claim 4, wherein the pre-resist pattern and the resist pattern have their respective T-shaped or reversed trapezoid longitudinal cross sections.
6. A fabricating method as defined in claim 1 or 2, wherein the pre-resist pattern and the resist pattern is made of a picture reversion type photoresist which is made by adding a negative working agent to a positive type photoresist including a mixture of alkaline soluble phenol resin and naphthoquinonediazido.
7. A fabricating method as defined in claim 6, comprising the steps of:
coating the picture reversion type photoresist on a given base material,
exposing the picture reversion type photoresist via a given mask,
heating the picture reversion type photoresist after the exposure treatment,
developing the picture reversion type photoresist after the heating treatment to form the pre-resist pattern, and
ash-treating the pre-resist pattern to form the narrowed resist pattern.
8. A fabricating method as defined in claim 7, further comprising the step

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of exposing the picture reversion type photoresist uniformly after the heating treatment and before the developing treatment.

9. A fabricating method as defined in claim 7, wherein the pre-resist pattern and the resist pattern have their respective T-shaped or reversed trapezoid longitudinal cross sections.

10. A fabricating method as defined in claim 1 or 2, wherein the pre-resist pattern and the resist pattern is made of a novolac type positive photoresist containing an additive phenol dissolution accelerator.

11. A fabricating method as defined in claim 10, comprising the steps of: coating the novolac type positive photoresist containing the additive phenol dissolution accelerator on a given base material,

exposing via a given mask and developing the novolac type positive photoresist, to form the pre-resist pattern, and

ash-treating the pre-resist pattern to form the narrowed resist pattern.

12. A fabricating method as defined in claim 11, wherein the pre-resist pattern and the resist pattern have their respective T-shaped or reversed trapezoid longitudinal cross sections.

13. A method for patterning a thin film using a resist pattern as defined in any one of claims 1-12.

14. A method for patterning a thin film, comprising the steps: forming a thin film to be milled on a given base material, forming a polymethylglutarimide layer on the thin film to be milled, forming a photoresist layer on the polymethylglutarimide layer, exposing and developing the photoresist layer via a given mask, partially removing the remaining polymethylglutarinide layer with an alkaline water solution to form a pre-resist pattern constructed of the photoresist layer as a top layer and the polymethylglutarinide layer as a bottom layer, ash-treating the pre-resist pattern to a narrowed resist pattern, and milling the thin film to be milled via the resist pattern to obtain a patterned thin film.

15. A patterning method as defined in claim 14, wherein the ashing treatment is carried out by using a process gas composed of oxygen gas containing at least one of fluorine-based gas and nitrogen/hydrogen gas mixture.

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16. A patterning method as defined in claim 14 or 15, wherein the pre-resist pattern and the resist pattern have their respective T-shaped or reversed trapezoid longitudinal cross sections.

17. A method for patterning a thin film, comprising the steps of:
forming a thin film to be milled on a given base material,
coating on the thin film to be milled a picture reversion type photoresist which is made by adding a negative working agent to a positive type photoresist including a mixture of alkaline soluble phenol resin and naphthoquinonediazido,
exposing the picture reversion type photoresist via a given mask,
heating the picture reversion type photoresist after the exposure treatment,
developing the picture reversion type photoresist after the heating treatment to form a pre-resist pattern,
ash-treating the pre-resist pattern to form a narrowed resist pattern, and
milling the thin film to be milled via the resist pattern to obtain a patterned thin film.

18. A patterning method as defined in claim 17, further comprising the step of exposing the picture reversion type photoresist uniformly after the heating treatment and before the developing treatment.

19. A patterning method as defined in claim 17 or 18, wherein the ashing treatment is carried out by using a process gas composed of oxygen gas containing at least one of fluorine-based gas and nitrogen/hydrogen gas mixture.

20. A patterning method as defined in claim 17 or 18, wherein the pre-resist pattern and the resist pattern have their respective T-shaped or reversed trapezoid longitudinal cross sections.

21. A method for patterning a thin film, comprising the steps of:
forming a thin film to be milled on a given base material,
coating a novolac type positive photoresist containing an additive phenol dissolution accelerator on the thin film to be milled,
exposing via a given mask and developing the novolac type positive photoresist, to form a pre-resist pattern,
ash-treating the pre-resist pattern to form a narrowed resist pattern, and
milling the thin film to be milled via the resist pattern to obtain a patterned thin film.

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22. A patterning method as defined in claim 21, wherein the ashing treatment is carried out by using a process gas composed of oxygen gas containing at least one of fluorine-based gas and nitrogen/hydrogen gas mixture.

23. A patterning method as defined in claim 21 or 22, wherein the pre-resist pattern and the resist pattern have their respective T-shaped or reversed trapezoid longitudinal cross sections.

24. A method for patterning a thin film, comprising the steps of:
forming a polymethylglutarimide layer on a given base material,
forming a photoresist layer on the polymethylglutarimide layer,
exposing and developing the photoresist layer via a given mask,
partially removing the remaining polymethylglutarimide layer with an alkaline water solution to form a pre-resist pattern constructed of the photoresist layer as a top layer and the polymethylglutarimide layer as a bottom layer,
ash-treating the pre-resist pattern to a narrowed resist pattern,
forming a thin film to be patterned on the base material so as to cover the resist pattern, and
lifting-off the resist pattern to obtain a patterned thin film.

25. A patterning method as defined in claim 24, wherein the ashing treatment is carried out by using a process gas composed of oxygen gas containing at least one of fluorine-based gas and nitrogen/hydrogen gas mixture.

26. A patterning method as defined in claim 24 or 25, wherein the pre-resist pattern and the resist pattern have their respective T-shaped or reversed trapezoid longitudinal cross sections.

27. A method for patterning a thin film, comprising the steps of:
coating on a given base material a picture reversion type photoresist which is made by adding a negative working agent to a positive type photoresist including a mixture of alkaline soluble phenol resin and naphtoquinonediazido,
exposing the picture reversion type photoresist via a given mask,
heating the picture reversion type photoresist after the exposure treatment,
developing the picture reversion type photoresist after the heating treatment to form a pre-resist pattern,
ash-treating the pre-resist pattern to form a narrowed resist pattern,
forming a thin film to be patterned on the base material so as to cover the

resist pattern, and

lifting-off the resist pattern to obtain a patterned thin film.

28. A patterning method as defined in claim 27, further comprising the step of exposing the picture reversion type photoresist uniformly after the heating treatment and before the developing treatment.

29. A patterning method as defined in claim 27 or 28, wherein the ashing treatment is carried out by using a process gas composed of oxygen gas containing at least one of fluorine-based gas and nitrogen/hydrogen gas mixture.

30. A patterning method as defined in claim 27 or 28, wherein the pre-resist pattern and the resist pattern have their respective T-shaped or reversed trapezoid longitudinal cross sections.

31. A method for patterning a thin film, comprising the steps of:
coating a novolac type positive photoresist containing an additive phenol dissolution accelerator on a give base material,

exposing via a given mask and developing the novolac type positive photoresist, to form a pre-resist pattern,

ash-treating the pre-resist pattern to form a narrowed resist pattern,

forming a thin film to be patterned on the base material so as to cover the resist pattern, and

lifting-off the resist pattern to obtain a patterned thin film.

32. A patterning method as defined in claim 31, wherein the ashing treatment is carried out by using a process gas composed of oxygen gas containing at least one of fluorine-based gas and nitrogen/hydrogen gas mixture.

33. A patterning method as defined in claim 31 or 32, wherein the pre-resist pattern and the resist pattern have their respective T-shaped or reversed trapezoid longitudinal cross sections.

34. A method for patterning a thin film, comprising the steps of:
forming a thin film to be milled on a given base material,
forming a polymethylglutarimide layer on the thin film to be milled,
forming a photoresist layer on the polymethylglutarimide layer,
exposing and developing the photoresist layer via a given mask,
partially removing the remaining polymethylglutarinide layer with an alkaline water solution to form a pre-resist pattern constructed of the photoresist layer as a

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top layer and the polymethylglutarinide layer as a bottom layer,
ash-treating the pre-resist pattern to a narrowed resist pattern,
milling the thin film to be milled via the resist pattern to form a pre-patterned thin film,
forming a thin film to be patterned on the base material so as to cover the resist pattern, and
lifting-off the resist pattern to obtain a patterned thin film including the pre-patterned thin film.

35. A patterning method as defined in claim 34, wherein the ashing treatment is carried out by using a process gas composed of oxygen gas containing at least one of fluorine-based gas and nitrogen/hydrogen gas mixture.

36. A patterning method as defined in claim 34 or 35, wherein the pre-resist pattern and the resist pattern have their respective T-shaped or reversed trapezoid longitudinal cross sections.

37. A method for patterning a thin film, comprising the steps of:
forming a thin film to be milled on a given base material,
coating on the thin film to be milled a picture reversion type photoresist which is made by adding a negative working agent to a positive type photoresist including a mixture of alkaline soluble phenol resin and naphthoquinonediazido,
exposing the picture reversion type photoresist via a given mask,
heating the picture reversion type photoresist after the exposure treatment,
developing the picture reversion type photoresist after the heating treatment to form a pre-resist pattern,
ash-treating the pre-resist pattern to form a narrowed resist pattern,
milling the thin film to be milled via the resist pattern to obtain a pre-patterned thin film,
forming a thin film to be patterned on the base material so as to cover the resist pattern, and
lifting-off the resist pattern to obtain a patterned thin film including the pre-patterned thin film.

38. A patterning method as defined in claim 37, further comprising the step of exposing the picture reversion type photoresist uniformly after the heating treatment and before the developing treatment.

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39. A patterning method as defined in claim 37 or 38, wherein the ashing treatment is carried out by using a process gas composed of oxygen gas containing at least one of fluorine-based gas and nitrogen/hydrogen gas mixture.

40. A patterning method as defined in claim 37 or 38, wherein the pre-resist pattern and the resist pattern have their respective T-shaped or reversed trapezoid longitudinal cross sections.

41. A method for patterning a thin film, comprising the steps of:
forming a thin film to be milled on a given base material,
coating a novolac type positive photoresist containing an additive phenol dissolution accelerator on the thin film to be milled,
exposing via a given mask and developing the novolac type positive photoresist, to form a pre-resist pattern,
ash-treating the pre-resist pattern to form a narrowed resist pattern,
milling the thin film to be milled via the resist pattern to obtain a pre-patterned thin film,
forming a thin film to be patterned on the base material so as to cover the resist pattern, and
lifting-off the resist pattern to obtain a patterned thin film including the pre-patterned thin film.

42. A patterning method as defined in claim 41, wherein the ashing treatment is carried out by using a process gas composed of oxygen gas containing at least one of fluorine-based gas and nitrogen/hydrogen gas mixture.

43. A patterning method as defined in claim 41 or 42, wherein the pre-resist pattern and the resist pattern have their respective T-shaped or reversed trapezoid longitudinal cross sections.

44. A method for manufacturing a micro device, using a patterning method for a thin film as defined in any one of claims 13-43.

45. A manufacturing method as defined in claim 44, wherein the micro device is a thin film magnetic head.

46. A manufacturing method as defined in claim 45, wherein the magneto-resistive effective type thin film element of the thin film magnetic head is manufactured by the patterning method as defined in any one of claims 13-43.

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